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Online only case report

Hemopericardium after laparoscopic perihiatal procedures: high index of suspicion facilitates early diagnosis and successful nonoperative management

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In the last 2 decades, the number of laparoscopic procedures performed to address both upper abdominal and lower thoracic pathology has increased. All bariatric surgeons must be intimately familiar with performing surgery in the area of the diaphragmatic hiatus and lower mediastinum, whether for a primary pathology or for an associated hiatal/paraesophageal hernia encountered during a bariatric procedure. The risk of intraoperative or postoperative complications related to laparoscopic hiatal hernia repair and standard antireflux or bariatric operations may be as high as 19% [1,2]. The risk of injury to surrounding structures must be appreciated and understood by all operating surgeons. Several case reports have cited the risk of cardiac and aortic injury during hiatal dissection and hernia repair [3,4]. Most of these complications have been related to the use of laparoscopic tacks, sutures, or dissection around the hiatus and near the thin portion of the diaphragm adjacent to the pericardium, resulting in hemopericardium and frank cardiac tamponade [3,4]. Without any current studies detailing the incidence of these severe complications, it seems that the actual risk is quite low. However, it is critical that surgeons operating in this region be aware of the risks and immediately consider the diagnosis in any patient who develops early signs or symptoms after surgery. Of great concern, the few case reports or available series describe cases in which the injury was diagnosed only at autopsy after the patient had died within days of the index surgery [3-5]. Other reports describe late diagnoses made only after the development of tamponade and hemodynamic instability necessitating emergent repair via median sternotomy and open cardiac surgery. Although postoperative hemopericardium progressing to tamponade is an immediately life-threatening process, if diagnosed early it may be amenable to relatively simple and nonoperative interventions [6,7].

We report a case of postoperative hemopericardium with tamponade after laparoscopic reduction and repair of a large hiatal hernia during a bariatric revisional procedure. To our knowledge, this is the first case report of this pathology that did not result in death or the need for open cardiac repair. This case illustrates the benefit of a high index of suspicion leading to a prompt evaluation and diagnosis that facilitated successful nonoperative management with percutaneous drainage. We also review the current literature and a search of the Food and Drug Administration (FDA) reports related to cardiac or aortic injury during perihiatal laparoscopic surgery, as well as discuss the evolving paradigm of nonoperative management of select cardiac injuries with hemopericardium.

Case presentation and management

The patient is a 31-year-old woman with a history of a prior open-banded gastric bypass (Fobi pouch) performed

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via an upper midline laparotomy in 2003 that presented with subjective loss of restriction and significant weight regain. Her weight at the time of presentation was 250 lbs, with a body mass index (BMI) of 44. A preoperative upper endoscopy was unremarkable. A fluoroscopic swallow study performed 3 months before the procedure found the expected banded-bypass anatomy and no evidence of a hiatal or paraesophageal hernia. Preoperative chest x-ray was also unremarkable. After workup, the patient underwent a laparoscopic exploration for planned revision involving conversion to a distal gastric bypass and possible resizing of the gastric pouch.

During the procedure, significant adhesions in the upper abdomen were encountered but were lysed without difficulty. A loop of bowel was identified anterior to the gastric remnant that was initially thought to be the Roux limb, but on further exposure it was discovered to be the transverse colon herniated through a large diaphragmatic defect that at first was assumed to be a standard paraesophageal hernia. However, on further inspection the herniated loop of colon was coursing anterior to the left lateral segment of the liver and into a large defect that was bordered by the xiphoid process anteriorly and the anterior wall of the esophagus posteriorly. The most likely etiology of this defect was felt to be from the original upper midline laparotomy that extended over the xiphoid process, and was either a direct injury to the anterior diaphragm or a retractor injury in the subxiphoid area, which then increased on size over the subsequent years. There was no posterior crural defect and no true hiatal hernia. The transverse colon was herniated into the mediastinum through the defect and was abutting the pericardium, but was able to be mobilized with anterior mediastinal dissection and completely reduced. There was no true hernia sac present, and only flimsy fibroadipose adhesions of the colon to the mediastinum and pericardium. The hiatal defect (10 cm) could not be primarily repaired due to the significant size, rigidity of the lateral edges, and the anterior location, and thus a mesh repair was performed. The mesh (Ethicon Physiomesh 10×15 cm; Ethicon, Cincinnati, OH) was secured in place anteriorly to the abdominal wall with several interrupted transfascial sutures, and laterally to the right and left margins of the diaphragmatic defect with intracorporeal sutures. Due to a difficult suturing angle at the most posterior area of the defect (adjacent to the anterior wall of the esophagus), the mesh was secured to the anterior portions of the right and left crus with several absorbable tacks. During the intraoperative hiatal suturing and placement of tacks, there was actually a discussion between the attending surgeon and the operating resident about the rare but reported risks of cardiac or pericardial injury and postoperative hemopericardium. The case continued and the anatomy of the previous bariatric surgery was fully explored. It was decided to proceed with the original plan, and a revision to a distal bypass (150 cm common channel) was performed without difficulty.

The patient was extubated and transferred to the surgical ward, and a postoperative chest x-ray found no abnormalities. The next day, the patient appeared well clinically and her vital signs had remained within normal limits throughout the night. However, later that day she acutely became anxious, tachycardic but normotensive, and described mild shortness of breath. An immediate evaluation was performed by the operating resident, including a stat echocardiogram based on the aforementioned intraoperative conversation about the rare risk of cardiac injury. The echocardiogram revealed a moderate-sized pericardial effusion with a partially filled right atrium and partially collapsed right ventricle consistent with early tamponade (Fig. 1). After discussion of the options of immediate open surgical exploration, temporizing pericardiocentesis followed by operative exploration, or percutaneous drainage only, the latter option was chosen based on the underlying etiology and the likely injury. The patient underwent an emergent right heart catheterization revealing equalization of pressures of the right heart, pulsus paradoxus, and pronounced respiratory waveform variation. Cardiology proceeded with fluoroscopic-guided percutaneous pericardiocentesis, and 370 mL of bloody fluid was aspirated with subsequent immediate normalization of vital signs and relief of symptoms (Fig. 2). After initial evacuation of the hemopericardium the patient was observed for 30 minutes with no sign of additional bleeding. A 6-French pericardial drain was then placed and the patient was monitored overnight in the intensive care unit. The drain was kept to bulb suction and serial surveillance echocardiograms were performed throughout the night without evidence of recurrent bleeding.

Drain output remained minimal and the following day the drain was removed and she was once again transitioned to the surgical ward for further recovery. An echocardiogram 24 hours postpericardiocentesis revealed no additional pericardial effusion, and the patient was started on colchicine for pericarditis prophylaxis. The patient's hospital course was subsequently uneventful and she was discharged home 2 days later. The patient fully recovered and resumed normal and full activity and has had no recurrence or additional problems at 18-month follow-up.

Discussion

To our knowledge, this is the first case report of an iatrogenic hemopericardium after perihiatal surgery that was successfully managed nonoperatively. To review the current literature discussing cardiac injury after hiatal hernia repair or fundoplication when the use staples or sutures were directly related, we searched the PubMed database for key words to include "cardiac tamponade," "cardiac injury," or "hemopericardium" with "hiatal hernia" or "fundoplication." The initial focus of our review was to search large cohort studies discussing outcomes and complications of

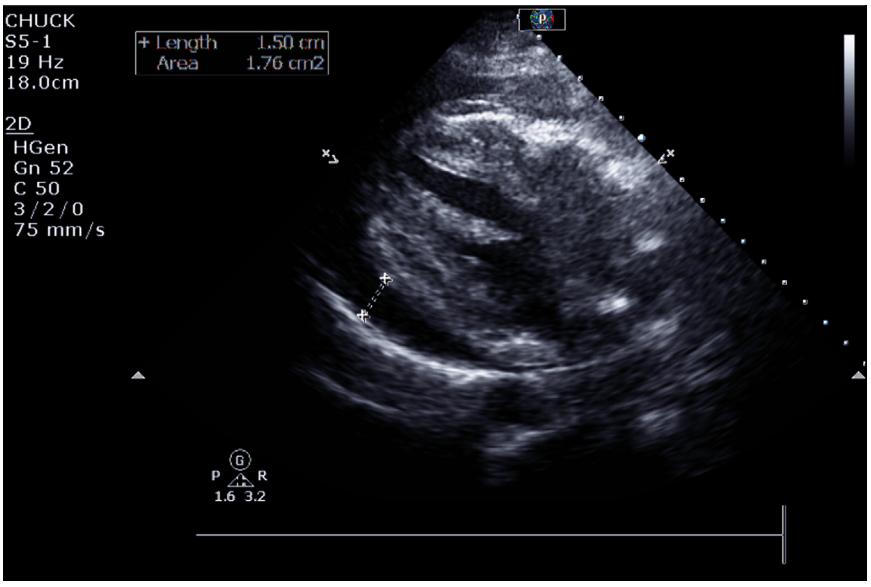

Fig. 1. Transthoracic echocardiogram revealing pericardial effusion. White line marks width of pericardial effusion.

laparoscopic hiatal hernia repair and then to further narrow our search to include smaller literature reviews and case reports.

A large retrospective study by Pessaux et al. discussed the outcomes of laparoscopic fundoplication to include short- and long-term complications [8]. Although they determined that bleeding is the most common intraoperative complication and a significant reason to convert to open surgery, the study did not mention a single cardiac injury, cardiac tamponade, or hemopericardium event as an intraoperative nor a postoperative complication. As expected and confirmed by Pessaux et al., cardiac and pericardial injury after laparoscopic fundoplication seems to represent an exceedingly rare complication, which explains the minimal amount of data published on this topic. However, there have been several case reports or case series that have called attention to the risk of cardiac injury during surgery around the diaphragmatic hiatus, particularly from various methods of securing mesh to the diaphragm. Frantzides et al. evaluated the reports of cardiac tamponade by reviewing current literature as well as searching the FDA's Manufacturer and User Device Experience (MAUDE) database [3]. They found a total of 15 cases of cardiac tamponade after hiatal hernia or ventral hernia repair. The causes of the injuries were all during the fixation of the mesh and were distributed between suture (n = 2), spiral

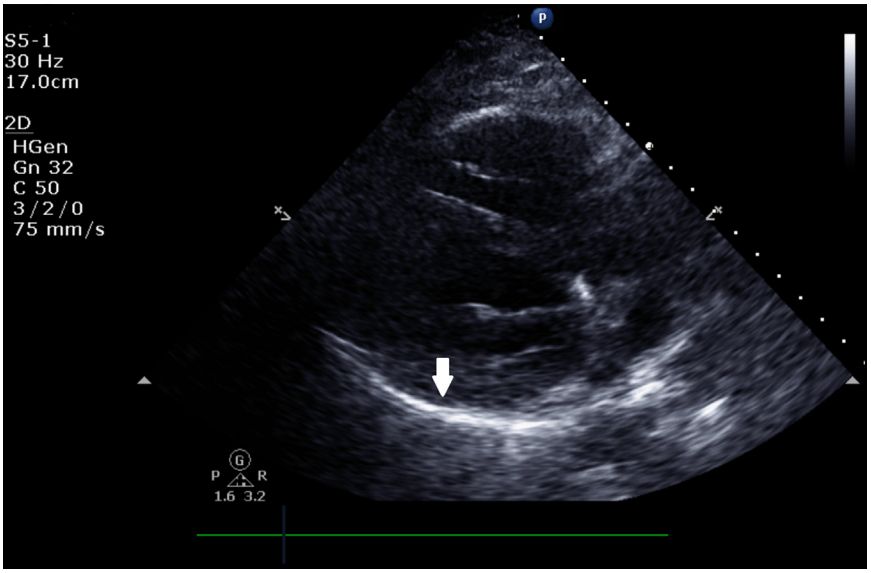

Fig. 2. Transthoracic echocardiogram after pericardiocentesis and drain placement. White arrow shows now resolved pericardial effusion.

tacker (n = 11), angled stapler (n = 1), and unknown (n = 1). Of greatest concern, 10 of these cases resulted in mortality, and the diagnosis of tamponade as the cause was only made postmortem. The remainder required emergent cardiac surgery with a significant attendant morbidity and prolonged hospital stay and recovery. We performed an updated search of the MAUDE database (2012 to 2015) and identified an additional 7 cases of cardiac injury from either the permanent spiral tacks or from the newer absorbable tacking devices. The majority of these injuries (86%) resulted in death due to cardiac tamponade, with the 1 survivor undergoing some type of open cardiac repair. As these cases highlight, the signs of tamponade (tachycardia and hypotension) can easily be confused for other more common postoperative complications such as bleeding or pulmonary embolism. This was also a significant concern in our case study. However, due to procedural awareness and a discussion intraoperatively about the risk of cardiac injury with any suturing or tack placement around the diaphragm, hemopericardium and cardiac tamponade were high on our differential. This is an important observation to be noted in the postoperative care of any case involving mesh fixation to the diaphragm, or with mediastinal, thoracoabdominal, or subxiphoid dissection performed. As found in this report, this may not only avoid an unnecessary iatrogenic death or major morbidity, but may facilitate definitive management with a minimally invasive percutaneous drain placement.

Although there has been a primary focus on the risk of this injury with use of the varying laparoscopic tacking or stapling devices, it is important to appreciate that the same result can occur with suture fixation to the diaphragm. This is highlighted in a review of 7 cases of cardiac tamponade after hiatal hernia repair, in which 5 (71%) were due to sutures [4]. In this series, 3 of the 7 patients died from unrecognized cardiac tamponade, with the remainder requiring median sternotomy, thoracotomy, or open transabdominal cardiac drainage and repair.

An additional aspect we present in our case study is the management option of percutaneous drainage only for a traumatic hemopericardium. Although the traditional international practice with posttraumatic hemopericardium has been to perform an immediate median sternotomy or thoracotomy and cardiac repair in all cases, this dogma is now being challenged in favor of a more selective approach. This was based on preliminary data finding that the majority (71%) of open cardiac explorations for hemopericardium from penetrating trauma were nontherapeutic and due to partial thickness injuries that spontaneously sealed [9]. In a subsequent prospective trial, stable trauma patients with hemopericardium were randomized to receive open repair versus subxiphoid pericardial window and drain placement only [10]. They found that pericardial drain placement after confirmation of hemopericardium via subxiphoid pericardial window (SPW) was well tolerated and effective, and avoided the morbidity of a median sternotomy.

The use of emergent pericardial drain placement as a temporizing measure when immediate surgical repair is not available has also been examined and validated [11]. These authors evaluated penetrating cardiac injuries (PCI) over a 16-year period and included 78 patients who survived a PCI and made it to the operating room alive. Of those patients, 39 underwent preoperative pericardial drainage and 39 underwent emergency thoracotomy. The authors found that the patients who underwent drainage only had an acceptably low mortality rate and shorter time to the operating room than the thoracotomy patients.

Although both of these studies focus on cardiac injury from penetrating trauma [10,11], the mechanism of injury and rationale for the high likelihood of successful nonoperative management in our patient is similar. The majority of cardiac injuries secondary to transdiaphragmatic tacks, staples, or sutures will be partial thickness, or at most a pinpoint full thickness injury. Although we cannot definitively identify the cause of the hemopericardium in this patient, we feel that the most likely etiology was from 1 of the tacks placed to the anterior left crus of the diaphragm. However, pericardial or cardiac injury from one of the sutures, or even from the dissection of the colon off of the pericardium, are also possible causes of the postoperative hemopericardium. We know from the experience with penetrating trauma that the vast majority of these types of injuries will seal spontaneously, and once the life-threatening problem of tamponade is treated with adequate pericardial drainage, there is little necessity for formal operative repair of the injury. However, this process entails strict adherence to proper patient selection, immediate diagnostic and therapeutic intervention, and close monitoring in an intensive care unit setting.

Conclusion

Cardiac injury after extensive subxiphoid and mediastinal dissection to include use of suture and tacks is an uncommon but potentially fatal complication. In our case, quick recognition, workup, consultation, and expedited intervention all led to successful life-saving treatment and successful nonoperative management. As mentioned in several articles reviewed, the signs associated with cardiac injury may be confused with other etiologies. However, increased awareness and communication within the surgical team would help identify these risk factors quickly. In addition, our management of the complication should be highlighted as we used an alternative but also less invasive and morbid technique to stabilize our patient. It is likely that increased awareness and vigilance for these types of postoperative complications will not only avoid preventable mortality and morbidity, but will also facilitate definitive management with minimally invasive techniques rather than open operative intervention. Of course the optimal outcome would be to avoid these complications altogether. Although

avoidance of tacks in any areas that are abutting the pericardium is an obvious take-home lesson, it should be appreciated that suturing in these same areas appears to carry similar risks. Complete visualization with no blind full-thickness suturing or tacking to the diaphragm, or using alternative methods such as tissue glues or angled-staples may also avoid inadvertent injury to the pericardium. Finally, taking the patient out of steep reverse-Trendelenburg position may also assist with reducing the apposition of the pericardium to the diaphragm.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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